

molecular size and constitution of the heavy carbohydrates, like starch and glycogen, and the family of dextrins intermediate between these and the sugars, we have at present little more than guesses to go upon. To give, as the present author does, long lists of reactions with iodine and other reagents, and on the strength of differences in these to describe as separate substances amylose, amyloosan, amyloextrin, and other forms of dextrin, and to add to the list amyloporphyrin and amyloerubin, does not really advance matters much. Bütschli apologises at the start for his lack of chemical knowledge, and in the end admits that several of his preparations are mere mixtures; we therefore fear that, from the chemists, his work will meet with but scant courtesy. He has nevertheless succeeded in producing a very readable little brochure, and if his main contention is accepted, his labours will not have been useless.

Lessons on Country Life. By H. B. M. Buchanan and R. R. C. Gregory. Pp. xi+330. (London: Macmillan and Co., Ltd., 1903.) Price 3s. 6d.

ONE of the authors of the above book, Mr. H. B. M. Buchanan, produced a little time ago two small "Country Readers," most excellent books for the children of a rural elementary school, in which our common domestic animals were discussed from a full knowledge in an easy, pleasant style. We are sorry we cannot give the same praise to the "Lessons" before us; the educational value of the former book has disappeared, and the authors have allowed a craving for completeness to swamp their judgment, so that the result is a miniature and scrappy encyclopædia instead of a book.

Country life is a vast subject, so vast that no child can learn during his school life even a fraction of the information it may be desirable he should possess in his after life; the teacher, then, must abandon the attempt to impart information, but devote his energies to instilling into his pupils the right way of looking at things, the method which they can employ themselves when going about the world. The method consists in a training in observation and experiment. Here instead we have first a sort of abbreviated textbook on live stock, hints on breeding and feeding, twelve breeds of cattle described at lengths varying from a page down to two lines, horses, sheep and pigs to correspond, analyses of milk, rules for making butter and cheddar cheese; with such a programme what chance is there of observation or experiment for school children?

The latter portion of the book deals with common birds and mammals in a much better spirit; strike out the unnecessary Latin names for orders, families and species, and it forms a fair reading book. The last section, on insects, is again spoiled by a wholly unnecessary passion for classification; classification is only grammar, and the parts of *τῆρας* are just as good in this way as "Coleoptera, Euplexoptera, Orthoptera, Thysanoptera, &c." We know by sad experience how easy the schoolmaster finds it to write these things on the blackboard and make his class copy them with due attention to neatness and spelling; observation and experiment require both labour and thought. We grieve to speak unkindly of Mr. Buchanan, who has done such excellent work before; there are good things in the book, e.g. the section on poultry and the illustrations, but, like the curate's egg, it is only good "in parts." If the new teaching on country life is to succeed in our schools, it will be in virtue of the spirit, and not of the information which the teacher imparts to his pupil, and we consider that this book fatally misses the spirit.

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LETTERS TO THE EDITOR.

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Radio-activity and the Age of the Sun.

IN the Appendix E of Thomson and Tait's "Natural Philosophy," Lord Kelvin has computed the energy lost in the concentration of the sun from a condition of infinite dispersion, and argues thence that it seems "on the whole probable that the sun has not illuminated the earth for 100,000,000 years, and almost certain that he has not done so for 500,000,000 years. As for the future, we may say, with equal certainty, that inhabitants of the earth cannot continue to enjoy the light and heat essential to their life for many million years longer, unless sources now unknown to us are prepared in the great storehouse of creation."

The object of the present note is to point out that we have recently learnt the existence of another source of energy, and that the amount of energy available is so great as to render it impossible to say how long the sun's heat has already existed, or how long it will last in the future.

The lost energy of concentration of the sun, supposed to be a homogeneous sphere of mass M and radius a , is $\frac{3}{8}\mu M^2/a$, where μ is the constant of gravitation. On introducing numerical values for the symbols in this formula I find the lost energy to be $2.7 \times 10^7 M$ calories, where M is expressed in grammes. If we adopt Langley's value of the solar constant this heat suffices to give a supply for 12 million years. Lord Kelvin used Pouillet's value for that constant, but if he had been able to use Langley's his 100 million would have been reduced to 60 million. The discrepancy between my result of 12 million and his of 60 million is explained by a conjectural augmentation of the lost energy to allow for the concentration of the solar mass towards its central parts. I should have thought the augmentation somewhat too liberal, but for the present argument it is immaterial whether it is so or not.

Now Prof. Rutherford has recently shown that a gramme of radium is capable of giving forth 10^9 calories. If, then, the sun were made of such a radio-active material it would be capable of emitting $10^9 M$ calories without reference to gravitation. This energy is nearly forty times as much as the gravitational lost energy of the homogeneous sun, and eight times as much as Lord Kelvin's conjecturally concentrated sun.

Knowing, as we now do, that an atom of matter is capable of containing an enormous store of energy in itself, I think we have no right to assume that the sun is incapable of liberating atomic energy to a degree at least comparable with that which it would do if made of radium. Accordingly, I see no reason for doubting the possibility of augmenting the estimate of solar heat as derived from the theory of gravitation by some such factor as ten or twenty.

In an address to Section A of the British Association in 1886 I discussed the various estimates which have been made of geological time, and I said, "Although speculations as to the future course of science are usually of little avail, yet it seems as likely that meteorology and geology will pass the word of command to cosmical physics as the converse." I think the recent extraordinary discoveries show that this forecast was reasonable.

It is probable that the bearing of radio-activity on the cosmical time-scale has occurred to others, but I do not happen to have seen any such statement.

Cambridge, September 20.

G. H. DARWIN.

The Principle of Radium.

WOULD some of your readers inform me whether the case of the radium phenomena is quite unique? When a small magnet in my drawer has been ready to act on a compass at any time during the last twenty years, and has not

altered its appearance in any appreciable way, I ask whence comes the continuous magnetic supply?

Again, when a lady has had for a great many years a cedar work-box which has never failed in its characteristic odour, it is a natural question to ask, whence comes the smell? The statement in books, both of physics and physiology, is that something material is given off from the wood which alights on the olfactory membrane of the nose. This is purely gratuitous, as the statement is without a shadow of proof, the box being to all appearances in no way diminished in size or otherwise altered. If the hypothesis, for it is nothing more, fails, how does the case differ in principle from that of radium?

S. W.

Normally Unequal Growth as a Possible Cause of Death.

I HAVE found from a good many years' experience that it is frequently difficult to assign any definite cause of death to the lower Vertebrata which die in the Zoological Society's Gardens from time to time. The examination of a large example of the Japanese salamander (*Megalobatrachus japonicus*), which lived for a good many (nineteen) years here, and measured some three feet in length, has suggested to me a rather curious and truly "natural" cause of death—if my inferences be correct. The animal showed no obvious signs of disease in any organ. Judging from its length it must have been old, for a specimen three feet long is asserted to have been at least fifty-two years old (*vide* Gadow, Cambridge Natural History, "Amphibia and Reptiles," p. 99). Comparing this specimen with one some twenty inches in length I found that the size of the heart, as of the other organs, was, as might be expected, actually larger, but that all the subdivisions of the heart were of the same proportions in the two animals. But in the course of a dissection of the heart it was plain that the two series of valves, which lie respectively at the anterior and at the posterior end of the pylangium, were so small, relatively speaking, that, when forced backwards by the pressure of blood in the entire conus arteriosus, they would not meet in the middle line. On the other hand, in the smaller salamander the three valves in question were in the first place situated closer together than in the large animal, being nearly in actual contact, and in the second place their size was so great in relation to the diameter of the pylangium that they would—or, I should rather say, could—meet after the systole of the ventricle. The fact is that these valves do not appear to grow *pari passu* with the general increase in size of the heart and the conus arteriosus. My own observations as to the small size of the valves in the large example are quite in accord with those of Hyrtl (*Cryptobranchus japonicus*, Vindobonae, 1865), who dissected an animal two and a half feet in length, and figures the valves, incorrectly as I believe in some particulars, but correctly in representing them to be of small relative size. It might be suggested, therefore, that the imperfection of the circulatory mechanism necessarily caused by the condition of the valves would lead to serious disturbances, and perhaps to death. If so the animal has a term put to its life by the mere fact that, while the heart grows with the increase in bodily size, the semilunar valves of the conus arteriosus do not.

FRANK E. BEDDARD.

Zoological Society's Gardens, London, N.W.

Can Carrier-pigeons Cross the Atlantic?

COULD any of your readers give me an answer to this query? It is stated in the *London Standard* (April 20, *circâ*) that this feat was accomplished in 1886, when three out of nine American carrier-pigeons set free in London returned to their home-huts. I have hitherto been unsuccessful in getting the authority for this particular experiment. From the points of view of bird migration and of seed dispersal, it is a query of considerable importance.

H. B. GUPPY.

21 Henleaze Gardens, Westbury, Bristol, September 21.

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A TECHNICAL SCHOOL FOR THE HIGHLANDS OF SCOTLAND.

THE difficult problem of catering for the educational needs of remote and isolated rural districts has been dealt with practically in this country by such enlightened benefactors as the Countess of Warwick in her school at Bigods, near Dunmow, in Essex, which has been carrying on its useful work for some five years, and which is now about to be made still more strictly into a school of agriculture, so as to bring it into harmony with the requirements of the district and of the counties which it serves. Lady Warwick's sister, the Duchess of Sutherland, has faced the still more difficult problem of providing a technical school for the Highlands of Scotland, and a preliminary account of the first scheme was given in these columns at the time of its inception (*NATURE*, vol. lxxv. p. 106, December 5, 1901). The work thus set going by Her Grace was formally inaugurated on September 8 by Lord Balfour of Burleigh, Secretary for Scotland, at a public ceremony held for the purpose of laying the memorial stone. The building, the design of which is by Mr. Dick Peddie, of Edinburgh, is already several feet above its foundations, and is situated on the picturesque slope of a hill overlooking the little town of Golspie, on the shore of Dornoch Firth, and within two miles of the beautiful grounds of Dunrobin Castle, the Scottish home of the Sutherlands. The main features of the educational scheme, as set forth in the statement published in our first notice, have been adhered to, but the details of a curriculum suitable for requirements of such a very diverse nature as have to be met in this remote Highland district can only be worked out by actual experience—it will be a case, as Lord Balfour said at the meeting, of *solvitur ambulando*. How diverse these conditions are will be realised when it is pointed out that the industries which have to be catered for are agriculture, almost entirely of the "crofting" type, textiles and dyeing, small mechanical trades and handicrafts, and fishing.

The ceremony on September 8, rendered picturesque by the surroundings and by the great gathering of some 2000 people from the neighbourhood and from all the towns and villages served by the Highland Railway from Inverness northwards, was opened by the singing of the Hundredth Psalm, and by a prayer for the success of the undertaking by Archdeacon Sinclair. The gathering was in itself a memorable one, the Duke of Sutherland, who presided, being supported by the Duchess and their family, by the Duke and Duchess of Portland, Mr. Andrew Carnegie and his partner Mr. Henry Phipps, Mr. R. B. Haldane, K.C., M.P., Prof. Meldola, by representatives of nearly all the leading Scottish families, by Members of Parliament, Provosts and Sheriffs, the Principals of the Scotch universities, the chairman of the governors of the Glasgow and West of Scotland Technical College, the conveners of the county councils, and by educationists of every class, including professors and inspectors of schools. Mr. James Macdonald, W.S. of Edinburgh, the hon. secretary of the school committee, had made himself responsible for the organisation of the meeting, which was in every way successful. After the laying of the stone, Lord Balfour said in the course of his speech:—

"This is to be a school for Sutherland and these other counties (Caithness, Ross and Cromarty). It is not only to be accessible to Sutherland and these other counties, as any other school might be, but it is a school expressly designed for the needs and wants of the district in which we are met. Its curriculum will be based on a careful study of the condition of things as they now exist, and will have, as the promoters